

August 1997

**THE WEST MONROE WATER PLAN
BLACK BAYOU WATERSHED**

**QUALITY ASSURANCE PROJECT PLAN (QAPP)
APPLICATION DEMONSTRATION PROJECT**

**DEQ CONTRACT NO. 514399
Submitted to:**

**Louisiana Department of Environmental Quality
Office of Water Resources
P.O. Box 82215
Baton Rouge, Louisiana 70884-2215**

Submitted by:

**City of West Monroe
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A.4 Project / Task Organization

The organization of the project team for the West Monroe Water Plan Black Bayou Watershed is presented in Figure A.4.1. A brief review of the primary staff and responsibilities for the management, quality assurance, and peer review is given below:

PROJECT MANAGEMENT

Contract Manager - Mr. Bruce Fleming, Director, Planning and Zoning, City of West Monroe is the Contract Manager and has primary responsibility for the contractual aspects of the project.

Principal Investigator - Mr. Jerry Madden, P. E., City Engineer has primary responsibility for the construction aspects of the project.

Principal Investigator - Dr. D. M. Griffin, Jr., Professor of Civil Engineering, Louisiana Tech University is responsible for preparing the QAPP. He is also responsible for experimental design, reports and data analysis.

The Contract Manager and the Principal Investigators have overall responsibility to ensure that all activities are performed in accordance with United States Environmental Protection Agency (U. S. EPA), Louisiana Department of Environmental Quality (LDEQ), and all other state and local requirements.

QUALITY ASSURANCE

Quality Assurance Officer - Ms. Karen Cummings, City of West Monroe is responsible for planning, implementing, and tracking quality assurance activities.

Mr. Xiangyou Dai - Mr. Dai is the Director of the Folk Environmental Lab at Louisiana Tech and also responsible for examining all analytical as it is produced for conformance with QA/QC criteria.

Ms. Hongjian Xiang - Ms. Xiang is responsible for the transfer of analytical data to the computer data base.

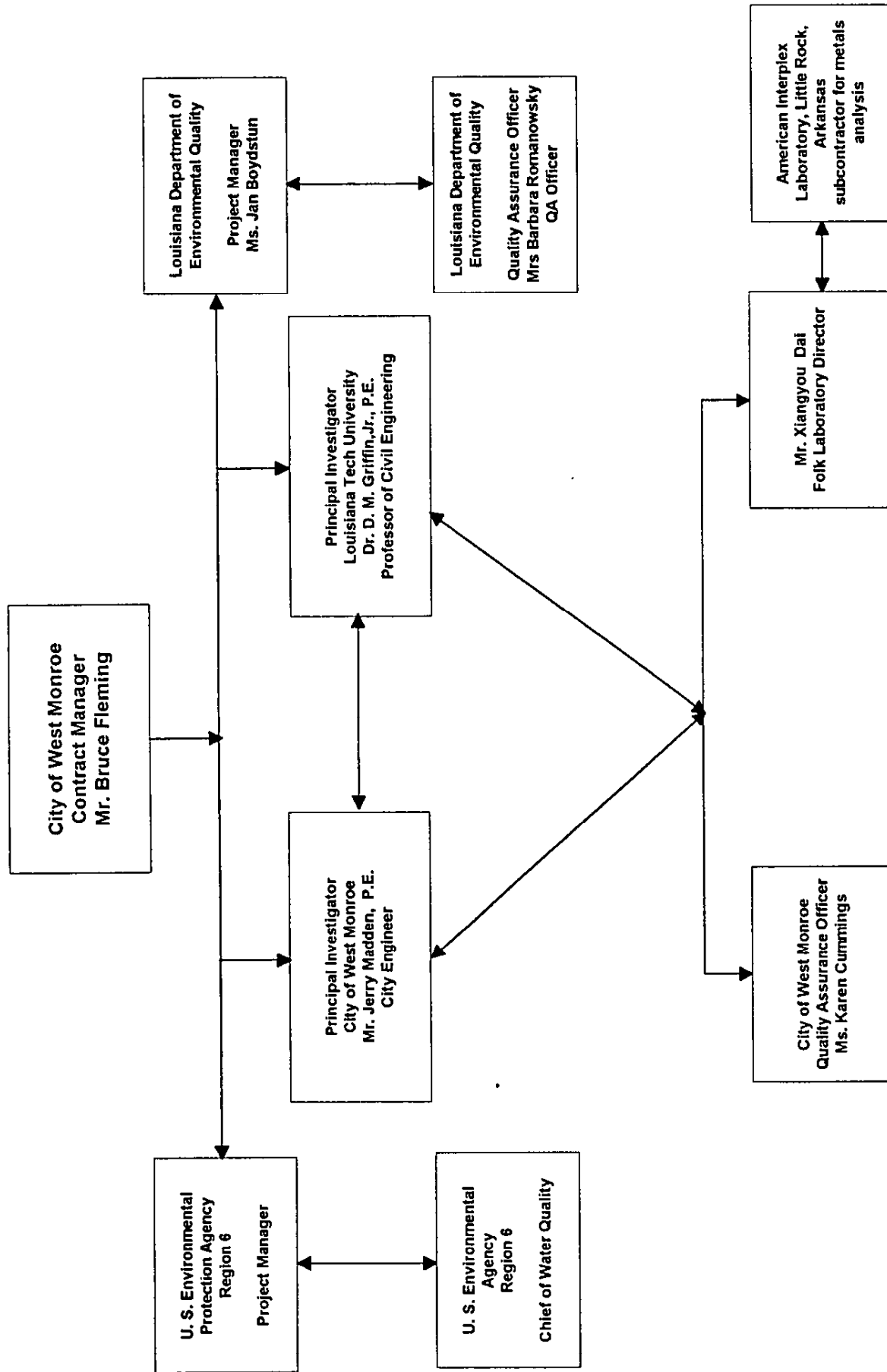


Figure A.4.1 Project Team Organization, Black Bayou Watershed Project

7i-flowchart

A.5 Problem Definition / Background

In 1993, Louisiana's Nonpoint Source Management Program targeted seven cities for a series of workshops on urban nonpoint pollution. The purpose of these workshops was to expand the role of LDEQ's Urban Nonpoint Source Subcommittee through outreach activities, which would provide more of a local forum to discuss the types of nonpoint source problems which exist within the areas of the state, where urban has been identified as a contributing source to water quality impairment. These workshops also provided information on what steps should be taken to alleviate nonpoint source problems through implementation of best management practices and educational programs. The target audience included city planners, engineers, and community leaders that could facilitate interest in the state's nonpoint source program. As a result of these workshops, the City of West Monroe submitted a project for funding through the 319 program.

The Black Bayou watershed encompasses 6430 acres, includes the City of West Monroe and drains into Cheniere Brake Lake (80802) and the Ouachita River (80101). The 1994 Water Quality Inventory Report indicated that Cheniere Brake Lake was only partially meeting its uses for secondary contact recreation and that the Ouachita River was only partially meeting all of its uses, with nonpoint sources of pollution being cited as contributing sources. LDEQ's Office of Water Resources has been collecting monthly water quality data from the Ouachita River at Monroe from January 1963, to the present. This data includes 22 different parameters, such as dissolved oxygen, nutrients, turbidity, organic carbon and metals. The Ouachita River was included in the 303(d) prioritization matrix and was listed as only partially meeting its designated uses because of both point and nonpoint sources. The causes of the water quality impairment included pesticides, priority organics, metals, organic enrichment and low dissolved oxygen, suspended solids, and pathogen indicators.

The City of West Monroe will construct a storm water detention basin in a sub-watershed of the Black Bayou Watershed. LDEQ's Nonpoint Source Unit is supportive of this demonstration project, as a method to implement an urban best management practice that has been recommended through EPA's Guidance for Specifying Management Measures for Control of Coastal Nonpoint Sources of Pollution for control of urban nonpoint source pollutants. In Chapter 2 of that document, a table was included which listed the advantages and disadvantages of management practices that could be used to meet the requirement of management measures for new development. The description for an extended detention wet pond indicated that it could provide peak flow control, serve large developments, and provide better nutrient removal when compared to wet ponds, in addition to enhancing aesthetics and providing for recreational benefits. The document indicated that the extended

detention wet pond could provide relatively high removal efficiency of total suspended solids, total phosphorus, total nitrogen, lead and zinc. The City of West Monroe should prove to be an excellent location to implement this type of urban best management practice within Louisiana, and determine its effectiveness in pollutant removal and water quality improvement.

The Black Bayou sub-watershed is approximately 820 acres which is roughly rectangular in shape and trending east to west, resting against the western boundary of the larger watershed. The sub-watershed is bisected by Interstate Highway 20, with the northern portions of the drainage being highly developed with both commercial and residential areas, and the lower portions consisting of forests and gravel pits. The project site will occur on 70.11 acres that is owned by the city, is located in the eastern half of the sub-watershed and is south of Interstate 20. The project is initially intended to be a single purpose recreation project, the city now realizes that a multi-objective project is more desirable for the city and this region of the state. The project is now intended to function as a demonstration project for reducing nonpoint sources of pollution from the commercial and residential development that is occurring along the western boundary of the city. The project will also provide flood control during peak flow periods within the Black Bayou watershed, in addition to an urban wetland detention area that will provide habitat for waterfowl and wildlife and an urban recreational area for the residents of West Monroe. A nonpoint source educational program component will be targeted toward the primary and secondary school system and urban developers and builders who have been requesting building permits to build within the watershed. The City of West Monroe has purchased the 70.11 acre site, and has obligated local matching funds for project planning, engineering design, and implementation.

The City will utilize the gravel pit as a detention pond to store runoff from the upstream, while at the same time reducing pollutants in the bayou. LDEQ's Groundwater Protection Division (GWPD) has reviewed soil and aquifer maps and made site visits to determine the steps that should be taken and additional groundwater aspects that should be considered to protect the ground water within this project area. It is anticipated that wetlands will be enhanced where they presently exist and encouraged where they offered opportunities for storm water retention and wildlife or fishery habitat. A structure of some design and preferably passive in operation will be necessary to allow for controlled release during and after storm events. In order to maximize the benefits of the projects beyond pollution reduction, flood control and conservation, the City will use part of the property for compatible activities, such as camping, hiking, etc.

A.6 Project / Task Description

The City of West Monroe has designated a watershed approach as the method which combines implementation of an EPA recommended best management practice with an educational program. The best management practice is the urban detention area which will function to detain urban storm water and pollutants during high flow periods and function as a recreational area during low flow periods. The urban educational program will educate school children about the various sources of nonpoint pollution and will also target developers and provide information on the steps that can be taken to reduce pollution from rapidly developing areas of the City. In order to achieve these project objectives, the project team recognizes that it must address the problems in the upper portions of the watershed through source reduction controls that could reduce the concentration of pollutants in the waters which move through the already intensively developed parts of West Monroe. By acknowledging early in the process, the inter-relationships between accelerated run-off from parking lots, streets, roof tops, and maintained yards, the team will be able to design and implement a project that is acceptable to the public, the City, the LDEQ, and EPA.

The project objectives include:

1. Evaluate the quantity and quality of runoff entering the watershed from upstream areas as a function of land use;
2. Evaluate the effectiveness of storm water detention basin in reducing nonpoint pollutant flux concurrently with lowering downstream water surface evaluations during storm events;
3. Enhance the habitat value of the surrounding wetlands for fish, migratory or resident waterfowl, non-game birds, and mammals adapting to urban growth;
4. Implement an educational program for City schools, developers and builders which encourage the use of non-point source urban reduction controls within the watershed; integrate the water and wetland features into a park that can be used by the City and Parish residents.

If the project is successful in meeting these objectives the city will be in the position of recommending improved land use management practices which can reduce the quantity and improve the quality of runoff entering the basin. In addition, the city will have quantitative information regarding how well an urban storm water detention facility reduces pollutant flux and lowers downstream water levels. This information can be extrapolated and used elsewhere.

This project will attempt to obtain runoff quantity, quality and pollutant flux data by measuring all significant flows into and out of the demonstration basin, including direct rainfall. Discrete samples will be collected over the hydrograph for a number of runoff events at each inflow and outflow point. Using this data a mass balance for both flow and pollutant mass can be constructed for the basin. These data will be obtained using commercially available flow measuring devices/samplers and totalizing rain gauges. Flow measurement, sample collection and sample analyses will be conducted in such a way as to provide accurate, reliable data. Details of the procedures used are described in this QAPP.

In general, the parameters to be measured during this project on the inflow and outflow from the storm water detention basin include the following:

1. Flow rate (gpm) at each measuring section
2. Fecal coliform bacteria
3. Total Kjeldahl nitrogen (TKN) - consists of ammonia-N as well as organic-N
4. Nitrate - N (NO_3^-)
5. Total phosphorus
6. pH, alkalinity, D.O., conductivity
7. Total suspended solids (TSS)
8. Iron [Fe], chromium [Cr], cadmium [Cd], nickel [Ni], lead [Pb], mercury [Hg], copper [Cu], zinc [Zn], aluminum [Al], Arsenic [Ar], Manganese [Mn]
9. BOD, COD - lumped measurement of organics
10. Chlorophyll A - An indicator of the presence of algae
11. Oil and grease - An indicator of pollution from autos and industrial activity

Parameters may be added to or deleted from this list or the sampling frequency changed as data collection progresses. The procedures for collection, storage, preservation, transport, holding times and analyses are provided in sections B.2 and B.3 elsewhere in this document.

Specific project tasks include the following:

1. Submit a draft detailed project plan and Quality Assurance Project Plan to LDEQ for review and comment;
2. Revise the draft plans according to LDEQ and EPA comments prior to initiation of any water quality sampling;
3. Select agencies, groups, or individuals who will be included in the interagency working group and in the implementation strategy for the project;
4. Prepare and mail letters inviting individuals, organizations, special interests, University personnel, and government representatives to participate in the program team;
5. Set meeting schedules for the program team and technical steering committee;
6. Establish procedures for making decisions;
7. Prepare a roster of individuals, special interests, businesses, organizations, politicians, and governments that must be kept informed throughout the planning process;
8. Acquire necessary flow measuring/ sampling equipment;
9. Install and test equipment;
10. Monitor and sample runoff events;
11. Tabulate and analyze data;
12. Preparation of necessary reports for funding agencies;

Presentations and Public Participation

The City of West Monroe will host public meetings to educate the citizens about the demonstration project and implement an educational program for children, adults, and developers on sources of nonpoint pollution and source reduction strategies which will be implemented to reduce urban pollutant loading within the City.

The following activities are planned to implement the educational program:

1. Host a public forum at City Hall to explain the project and a schedule to solicit public ideas for incorporation into the draft program. All written and oral comments will be compiled and/or summarized for future reference by the program team.

2. Host a Public Hearing at City Hall to present the draft plan for the 70.11 acres wetland detention basin and recreational area. The public hearing will be jointly hosted by Rod Emmer and Associates and the City of West Monroe, and will describe the process that led to development of both projects then discuss the proposals. Following the formal presentations, the audience will be asked to share its opinions. Written or oral comments will be used for revising the draft.

3. The team will meet with adjacent landowners and the school system to discuss the project and the importance of their involvement. Participation by the school system, especially for the assistance in the type of exhibits, trails, and facilities that will meet the needs of primary and secondary science and environmental classes.

4. Work with LDEQ's NPS staff on implementation of an educational program for school children, directed at storm drain stenciling activities within the watershed, and information on environmentally responsible lawn care practices.

5. Work with LDEQ's NPS staff on implementation of a series of workshops for developers within the watershed, providing information on construction best management practices which should be utilized to reduce pollutants at their source within the watershed.

6. Work with LDEQ's NPS staff on implementation of an educational program for golf courses within the watershed, targeting nutrient and pesticide management and storm water control measures that can be utilized to reduce nonpoint source runoff within the watershed.

A.7a Data Quality Objectives for Measurement Data

One major objective of this the data collected during this study is to quantitatively determine the effect of a flow-through urban holding basin on pollutants generated from nonpoint sources.

The parameters to be measured during this effort have been previously listed in section A-6. A brief description of the significance of each is provided below.

Flow Rate

Measurement of flow into and out of the holding basin is necessary for computing the mass of contaminants retained in the basin during any specified period of time. Flowrate measurements will be obtained using sampler/flow meters installed at major inlets and outlets of the basin. Data will be logged into flow meter memory and downloaded periodically using a laptop computer. Using this data runoff hydrographs can be plotted. Numerical integration of a hydrograph over time will give the volume passing the measuring section during that period. Rainfall amounts will be recorded using totalizing, tipping bucket rain gauges with the capability to log the recorded data. These will also be downloaded periodically using computers. The volume of water entering the system directly from rainfall will be estimated by multiplying the area of the basin by the rainfall amount.

Biochemical oxygen demand (BOD₅), chemical oxygen demand (COD)

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) are gross measures of organic pollution used commonly in the field of waste treatment. Simply put BOD measures the oxygen equivalent of organic material consumed by microorganisms over a 5-day period under specified environmental conditions. While the test has a number of technical shortcomings it has been used routinely since the turn of the century, thus investigators have substantial experience and "feel" for the test results. In addition, it has been codified into the pollution laws and regulations of the country as a primary means of determining whether or not existing treatment requirements are being met. By comparing the BOD of nonpoint contamination to that of wastewater we can get some perspective on the severity of the problem.

Chemical oxygen demand (COD) is a measure of the oxygen equivalent of organic material in wastewater subjected to chemical oxidation. The test can be done easier and faster than the BOD test. The test results are generally more precise and reliable. By comparing the BOD and COD of a waste, some idea of the level of biodegradability is possible.

Total suspended solids (TSS)

Total suspended solids is used as measure of the amount of material in water or wastewater which can be filtered out. It has been in use for some time and there is substantial data available for comparison. Excess solids in water can effectively eliminate plant life by covering or cutting off sunlight. Excess solids in water can also interfere with higher life forms (fish) by interfering with oxygen transfer mechanisms such as the transfer across gill membranes.

Alkalinity, Temperature, Dissolved Oxygen, pH, Conductivity and Hardness

These tests, for the most part, can and should be done on-site and will provide basic information regarding water quality and its potential as suitable environment for life forms. pH is a measure of the degree to which water or wastewater is 'acid' (pH<7.0) or 'basic' (pH>7.0). Liquids with a pH of 7.0 are said to be 'neutral'. Most healthy environments are characterized by a pH near neutral and most life forms require a pH near neutral for survival and reproduction. Alkalinity is a measure of the resistance of a water or waste to external influences which would change the pH. In most natural waters alkalinity is created from the 'carbonate buffer system' originating in the underlying geologic formations. In this context measurement of hardness provides an estimate of the extent to which alkalinity is a result of the carbonate buffer system. Based on the discussion above, alkalinity is a desirable characteristic of most aquatic environments.

Dissolved oxygen or the lack thereof is probably the single parameter most often associated with organic contamination of water. Its presence is required for aesthetic purposes as well as for the survival of most higher life forms. Conductivity is a surrogate measurement for TDS.

Total Kjeldahl Nitrogen, Nitrate-Nitrogen, Ammonia

These tests measure various forms of nitrogen in water or wastewater. Nitrogen is important for two reasons. First the presence of reduced forms of nitrogen can be indicative

of relatively recent organic pollution. Second nitrogen is one of the primary nutrients controlling the growth of aquatic plants and algae.

Total Kjeldahl nitrogen is a measure of the sum of ammonia plus organically bound nitrogen. Ammonia ($\text{NH}_3/\text{NH}_4^+$) is a constituent of wastewater resulting from the decay of urea, a form of organic N. It is toxic to fish in higher concentrations and is thus regulated in some waste discharges. Organic nitrogen is nitrogen tied up in larger molecules. Because organic nitrogen decays rapidly to ammonia under appropriate environmental conditions TKN may be viewed as measuring the ammonia "potential" of a discharge.

Nitrate nitrogen can result from a 2 step bacterially mediated, ammonia oxidation process as well as from direct application of fertilizers and other lawn care chemicals. This form is generally available for plant uptake. As a result nitrogen is often implicated as a limiting nutrient in cultural eutrophication.

Total Phosphorus

Phosphorus is the other primary nutrient, along with nitrogen, associated with the accelerated growth of algae and aquatic plants. Total P encompasses phosphate (PO_4^{3-}) as well as reduced forms tied up in larger molecules. Phosphate is the primary form of phosphorus available to aquatic plants. Phosphorus enters runoff primarily as a byproduct of excessive fertilizer application.

Fecal Coliforms

Coliforms are a ubiquitous bacterial genus associated with organic contamination. Fecal coliforms are a subset of the coliforms associated with the waste of warm blooded animals. Fecal coliform levels have been codified into existing regulations as a primary means of determining the acceptability of water for potable consumption or contact recreation. The concentrations of the bacteria in nonpoint contamination when compared to these levels help provide a context in which to judge the severity of the problem

Chlorophyll A

Chlorophyll is required by plants to carry out photosynthesis. It is commonly used as an indicator of the presence of algae.

Oil and Grease

A lumped measurement of the potential effect of automobiles and other petroleum powered devices on the quality of nonpoint contamination. If found in high enough concentrations additional samples may be collected and further analyzed for specific petroleum based compounds.

Metals (arsenic, aluminum, copper, chromium, cadmium, mercury, iron, manganese, lead, zinc, nickel)

Metals enter nonpoint runoff as a result of wide variety of activities including automobile use and a myriad of industrial operations. Maximum allowable concentrations of many of these metals in surface waters have been established by the EPA as well as LADEQ.

Iron (Fe), copper (Cu), manganese (Mn) and zinc (Zn) are essential heavy metal nutrients essential for plant and animal growth and body maintenance. They may also be produced as debris from automobile and industrial activity.

Cadmium (Cd), lead (Pb), chromium (Cr) and nickel (Ni) are heavy metal elements not essential for plant and animal growth or body maintenance. Concentrations of these heavy metal elements, organic and inorganic forms, in surface and ground water may achieve levels that are toxic for animal and plant life.

Aluminum (Al) is produced as by product of automobile and industrial uses. It has been suggested that buildup of aluminum in the brain may be one factor in Alzheimer's disease. Mercury (Hg) is a by-product of industrial and manufacturing operations. Mercury is a concern as it has been found in elevated concentration in many of the rivers and lakes in north Louisiana.

By comparing the concentrations of these metals in runoff entering and leaving the site to levels considered safe by regulatory agencies it will be possible to develop some idea of the magnitude of nonpoint contamination on local water courses. It will also be possible to determine the effectiveness of a runoff holding basin in attenuating the export of these contaminants.

Data Quality Objectives

The purpose of this quality assurance/quality control document is to establish those procedures which will be followed in order to produce analytical data which can be used with

confidence for the intended computations and predictions as set forth herein. In this regard this program shall:

Provide a rational and quantitative method for evaluation of the quality and reliability of analytical data obtained, thereby allowing data lacking in procedural accuracy, analytical accuracy, precision, completeness or other characteristics to be discarded or otherwise noted.

A discussion of precision, accuracy completeness and representativeness are provided in the sections below. Specific calculation formulas and their use are provided in Section D.

Analytical Measurement Data Characteristics

Precision:

Precision measures the reproducibility of repetitive measurements. It is defined as the degree of mutual agreement among independent measurements resulting from repeated application of the same processes under similar conditions. It should be noted that precision makes no specific reference to the "correct" value, if it is known. **Analytical precision** is a measurement of the variability associated with duplicate (2) or replicate (more than 2) analyses of the same sample in the laboratory and is determined by analysis of matrix spike duplicates or laboratory control sample duplicates. This definition does not include replicate variation which may occur because of variation in collection procedures in the field. **Total precision** is the measurement of variability associated with the entire sample collection, transport and analysis process. It is determined by analysis of duplicates or replicates of **field samples** and includes all possible sources of variability (collection, transport, etc.). As an example, a single sample would be collected in the field and subdivided into replicates; these would then be transported back to the lab and analyzed.

In the study imprecision will be estimated using the relative percent difference (RPD) between duplicate measurements of laboratory control samples.

Precision goals are presented in tables in Section B.5 for each method. Precision goals will be met if duplicate analyses of laboratory control samples agree within RPDs specified in Section D. RPDs for laboratory control samples outside specified limits indicate the analytical system is out of control and requires samples to be reanalyzed. Data already obtained will be flagged and or discarded. Precision may also be assessed by matrix spike duplicates.

Results of field duplicates will be used to evaluate the total imprecision possible in natural matrix sample results.

Accuracy

Accuracy is a statistical measurement of correctness, and includes components of random error (variability due to imprecision) and systematic error (bias in sampling or analyses procedures). Thus, it is possible for measurements to be precise but inaccurate as well as accurate but imprecise. A measurement is accurate when the value reported does not differ from true value. Analytical accuracy is typically measured by determining the percent recovery of known analytes that are spiked into a field sample (a matrix spike) or reagent water (a method spike). The stated accuracy objectives apply to spiking levels at five times the method detection limits or higher. The individual methods provide equations for acceptance criteria at lower spiking levels. It should be noted that there are no generally accepted analyte spikes for solids (TSS) determinations.

Both accuracy and precision are calculated for specific sampling or analytical batches, and the associated sample results must be interpreted considering these specific measures. Application of calculated precision and accuracy to measurement sample results is discussed in Section D.3. An additional consideration in applying accuracy and precision is the concentration level of the samples; a procedure capable of producing the same value within 50 percent would be considered precise for low level (near the detection limit) analyses of minor constituents, but would be unacceptable, and possibly useless for major constituents at high concentrations.

Accuracy goals for laboratory control samples are presented in tables in Section B.5. Accuracy goals will be met if individual laboratory control sample recoveries are within listed criteria. Laboratory control sample recoveries outside criteria indicate the analytical system is out of control and require samples to be reanalyzed. Data obtained will be flagged and or discarded.

Completeness

Completeness is calculated from the aggregation of data for each method for any particular sampling event. For each method, the number of valid results, divided by the number of individual analyte results initially planned for, expressed as a percentage, determines the completeness for the data set. The objective for completeness is 90 percent.

If there are any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and reanalysis were not possible, samples spilled or broken, etc), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

Valid results used to meet completeness objectives are those results which provide defensible estimates of the true concentration of an analyte in a sample. These valid results include data which is not qualified and data which QC results indicate qualification is necessary but the data may still be used to meet project objectives. Invalid results are those data for which there is an indication that the prescribed sampling or analytical protocol was not followed.

Representativeness

Objectives for representativeness will be defined for each sampling and analysis task and will be a function of the investigative objectives. Representativeness will be achieved in part, through the use of the standard sampling analytical procedures described in the QAPP and the Field Sampling Plan. Representativeness is also determined or influenced by appropriate program design, considering elements such as sampling location. A specific example of data representativeness in this study would be the degree to which discrete samples are collected evenly across the hydrograph of a runoff event. This depends on several factors including the shape of the hydrograph and the type of trigger used to initiate sample collection (water surface elevation, flow rate, volume). Because constituent concentrations vary dramatically in runoff, a hydrograph wherein only one or two samples are collected, or where samples are collected on only a portion of it may give inaccurate estimates of mass export during an event.

Comparability

Comparability is the confidence with which one data set can be compared to other data sets. The objectives for this QA/QC program are to produce data with the greatest degree of comparability possible. Comparability will be achieved by using standard methods for sampling and analysis, reporting data in standard units, and using standard and comprehensive reporting formats. Analysis of reference samples may also be used to provide additional information that can be used to assess comparability of analytical accuracy produced within the laboratory.

Goals

The quality assurance objective (i.e., goal) for this project is to have all analyses performed on an analytical system that is in statistical control and meets method specifications. Numerically, the goal is to have all individual results traceable to a laboratory control sample (where appropriate for the method) whose recovery (for both precision and accuracy) is within method-specified limits. Methods specifications will be used as tolerance limits for the project. Laboratory derived limits used to statistically monitor analytical system control will be within method specifications. The method-specified limits for laboratory control samples are supplied in Section B along with method-specific limits for spike recoveries in natural matrix samples. Inaccurate or imprecise recovery of laboratory control samples will invalidate results. Inaccurate or imprecise recovery of spikes in natural-matrix samples will not necessarily invalidate results. Poor recoveries of spikes in natural-matrix spikes can indicate the potential for matrix effects. A conclusion of matrix effects must be supported by laboratory control sample results within acceptance criteria for the analytical batch for which the matrix spike was performed.

A.7b Sampling Program

The major objective of this project is to implement an effective water quality sampling program that can be used to evaluate the effectiveness of an urban, wetland detention basin in reducing the concentration and total mass export of nonpoint source pollutants in West Monroe's stormwater runoff from the surrounding catchment.

Water quality monitoring is the most direct and best tool available to evaluate water quality and its response to management practices and other factors. The sampling program proposed to be implemented as part of the City of West Monroe Storm Water Detention Basin Project has as its objective to determine the impact of storm water detention on pollutant loads and consequently water quality downstream of the project. Nonpoint sources may generate both conventional and toxic pollutants. Therefore, knowledge of the pollutant characteristics entering the system as well as their behavior during normal flow and storm events is important in selecting, implementing and evaluating a management program.

In developing such a monitoring program, two factors must be considered and balanced. First, the acquisition of large quantities of valid and verifiable data is time consuming, labor intensive and thus expensive. Second, sufficient data must be collected such that reliable conclusions can be drawn from valid statistics. These factors have been considered in developing the sampling program. It has been decided that fewer storms measured intensively is better than measuring a larger number storms at a much lower level of intensity. The use of automatic samplers for collecting discrete samples based on flow, water depth or other factors does not guarantee that every event is sampled uniformly across the event hydrograph. This approach provides the investigators flexibility in choosing those storm events where an adequate number of samples were collected at appropriate places on the event hydrograph. This will provide greater accuracy in computing pollutant loads. In addition, the investigators will have the flexibility to closely monitor and sample events which occur under unusual circumstances (i.e. long antecedent dry period, unusual land use activity) It is felt that the conclusions drawn from such an effort will have greater validity. The sampling program combines upstream-downstream (UD) and inflow-outflow (IO) design. UD sampling strategies are generally more useful for documenting the size of a nonpoint source than for documenting the effectiveness of nonpoint source control measures. The IO design portion is probably the most significant part of the monitoring program. It allows the concentration of a particular parameter, sediment, for example, to be measured at the inlet to a basin and at the outlet of a basin. When combined with concurrent flow measurements the general effectiveness of the basin can be determined.

The parameters to be measured in determining the effectiveness of a storm water detention basin include the following:

Table A.7b.1 Parameters to be Measured During Study

TEST	METHOD	SOURCE	TEST LOCATION
BOD***	SM 5210 B	Standard Methods*	Folk Lab ³
COD***	5220 D	Hach ¹ , Standard Methods	Folk Lab
TSS	TSS 2540 D	Standard Methods	Folk Lab
TKN	SM 4500orgB 4500orgC	Standard Methods	Folk Lab
Nitrate	SM 4500 NO ³ E		Folk Lab
Ammonia (as Nitrogen)	4500-NH ₃ E	Standard Methods	Folk Lab
Alkalinity	SM 2320 B	Standard Methods, Hach	Field, Folk Lab
Conductivity	SM2510 B	Standard Methods	Folk Lab
Temperature**	SM 2550 B	Standard Methods, American Sigma	continuously logged field measurement
Dissolved Oxygen	SM 4500-O G	Standard Methods, American Sigma	continuously logged field measurement
pH**	SM 4500 -H ⁺ B	Standard Methods, American Sigma	continuously logged field measurement
Hardness	SM 2340 C	Standard Methods, Hach	Folk Lab
Total Phosphorus	4500-PB.		Folk Lab
Fecal Coliforms	909-C	Millipore ² , Standard Methods	Folk Lab
Chlorophyll "A"	SM 10200 H	Standard Methods	Folk Lab
Oil and grease ⁴	SM 5520 C	Standard Methods	Folk Lab

+TPH
—

METALS ANALYSES

TEST	METHOD	SOURCE	Test Location
Lead***	3120 B	EPA, Standard Methods	American Interplex Labs
Arsenic***	3120 B	EPA, Standard Methods	American Interplex Labs
Aluminum***	3120 B	EPA, Standard Methods	American Interplex Labs
Copper***	3120 B	EPA, Standard Methods	American Interplex Labs
Chromium***	3120 B	EPA, Standard Methods	American Interplex Labs
Cadmium***	3120 B	EPA, Standard Methods	American Interplex Labs
Mercury***	3120 B	EPA, Standard Methods	American Interplex Labs
Iron***	3120 B	EPA, Standard Methods	American Interplex Labs
Manganese***	3120 B	EPA, Standard Methods	American Interplex Labs
Nickel***	3120 B	EPA, Standard Methods	American Interplex Labs
Zinc***	3120 B	EPA, Standard Methods	American Interplex Labs

* 1992 Edition of Standard Methods

** test done at time of sample collection, in field

¹ Hach materials variations in procedure will be used

² Millipore materials and procedure variations will be used

³ Located at Louisiana Tech University

*** filtered (soluble) and unfiltered analyses will be conducted

⁴ Further analyses for specific petroleum based compounds may be warranted based on these results

Flow Measurement

Flow measurements will be obtained using commercially available sampler/flow meters capable of measuring flowrates using one or more of the following; pressure transducers, doppler velocity probes or programmed Manning's Equation. These samplers can be programmed to sense and log flowrate at specified intervals thus allowing construction of a runoff hydrograph for each event. In addition, the collection times of discrete samples are also logged. The samplers can be programmed for pre and post purge and rinse cycles to prevent cross contamination. The samplers will be equipped with probes which will continuously monitor pH, temperature and dissolved oxygen. Sampler/flow meters, equipped with probes will be located at the inlet and outlet of the holding pond. Each sampler will be attached to a recording rain gauge. Logged data will be periodically downloaded via laptop computer.

Data Collection Objectives

The data collected will be used in number of ways.

1. The form of the contaminants (particulate vs soluble) can be determined at the basin inlet and outlet. Such information is useful in determining and evaluating the treatment process occurring in the basin (i.e. settling).
2. Concentration of contaminants measured will be compared to available standards as well as to concentrations found in wastewater. This will allow the investigator(s) to place the runoff quality in perspective with other environmental problems.
3. Using commercially available software (MathCad 7.0 Pro) pollutant loads entering and leaving the basin can be computed for selected events. This will provide a quantitative measure of basin effectiveness in terms of pollutant removal. This provides a direct measure of the effectiveness of the facility in reducing downstream pollution.
4. Pollutant flux rates can be examined as a function of rainfall characteristics. For example, in a similar project in Shreveport, Louisiana it was found that pollutant loads correlated directly with maximum rainfall intensity rather than total rainfall amount.
5. By computing and plotting cumulative event volume passing the measuring section vs the cumulative pollutant during a runoff event a quantitative measure of the degree of pollutant flushing can be obtained (i.e. 80% of a pollutant is carried into the basin in 20% of the entering flow or vice versa). This effect can be examined as a function of the type and form of the pollutant as well as rainfall characteristics. The same can be done regarding the basin outlet. This provides another quantitative measure of basin effectiveness.

Sample Collection and Preservation

Difficulties can arise regarding holding times and appropriate sample preservation during nonpoint studies because of :

1. Length of storm event
2. Time required to retrieve samples once an event has occurred
3. Number of samples, sample size, container type and preservative requirements for various analytical tests.

It does not appear practically possible to completely reconcile all of these various requirements. In this study refrigerated samplers will be used to reduce the temperature of collected samples to less than 4° C. At this point it appears that the most feasible type of sample containers are 1 liter polypropylene containers. These can be used in lots of 24 in the samplers. While glass containers are available they were found to be too small (350 ml.) to collect adequate sized samples or so large (1.9 liter) that only 8 could be used in a sampler at once.

Once samples are retrieved, appropriately sized aliquots will be placed in glass or polypropylene containers as required and the necessary preservatives added (Table 1060-I, Standard Methods, 1992). Samples will stored in insulated coolers with ice for transport to the appropriate laboratory. Every effort will be made to minimize the time between the occurrence of a storm event and sample retrieval. Every sample container will be labeled with the project title (West Monroe), source of the sample (inlet sampler), date, time, sample collection number (1-24). Writing instruments shall use indelible ink, not subject to running. Labels shall be of a type that is removable. If a sample is split between containers ALL information on the original label shall be put on subsequent container labels as well as any preservatives added (i.e. HCL). New labels will be affixed to all sample bottles each time they are used. Previous label information may not be crossed out in order to reuse label.

Graduate students who have the responsibility of retrieving samples shall maintain field log books. They will record the time and date of each visit. Names of person(s) visiting the site, site condition, observations regarding samplers and samples and any other unusual conditions.

Laboratory Procedures - Folk Lab

Samples returned to the Folk Memorial Laboratory will be logged in a separate notebook maintained for each project. Login information will include responsible individual location, date and time of collection, date and time of return to the lab, sample number, container type, preservatives added, tests to be run, and storage location in the lab.

Laboratory Personnel

At present Folk Laboratory personnel consist of the following:

Xiangyou Dai M.S. - Laboratory Director / Research Associate, responsible for day to day operation of the lab, training of research assistants, maintenance of acceptable QA/QC.

Ms. Karen Cummings, B.S. - City of West Monroe, responsibility for field work and some lab testing. Serves as the City's technical representative.

Rishi Raj Bhatteai, M.S. - Research Associate, overall responsibility for the project field work and equipment maintenance, data manipulation and analyses

Hongjian Xiang, B.S. - Graduate research assistant, responsible for COD testing, data base maintenance on computer spread sheets, (EXCEL). Data manipulation and analyses.

Sashi Shretha, B.S. - Graduate research assistant, responsible for sample collection, TSS and VSS analyses.

Mehran Eslami, B.S. - Graduate research assistant, responsible for sample collection, TSS and VSS analyses

Student - Undergraduate, responsible for keeping laboratory clean, washing glassware and plastic ware.

D. M. Griffin, Jr., PH.D., P.E. - Principal Investigator, overall project responsibility, budget responsibility, purchasing responsibility, washing glassware and plastic ware.

It is anticipated that within the next 6 months 2 of the research assistants will graduate and be replaced by others.

A.8 Project Narrative

Project success will be determined through the evaluation of flow rates as well as the physical/chemical constituents presented in Section A.6. Success will be determined by being able to: 1. compare pond effluent parameters to discharge standards as well as values for raw and treated wastewater. This will provide some perspective on the amount of contamination entering the environment 2. Compare pollutant mass entering the system to that leaving the system for specified runoff events as described in section A-7b. The sampling design, types of samples and location requirements are discussed in Sections B.1 and B-2. Sample handling and custody requirements are discussed in section B.3. Analytical methods and QA/QC procedures are discussed in Sections B.4 and B.5. The requirements for analytical instrumentation are presented in Section B.6. Reconciliation with data quality objectives is discussed in section D-3.

Prior to the collection of the first set of samples, an independent analytical laboratory (American Interplex, Little Rock Arkansas) will be asked to review our sampling procedures. Representatives of LDEQ will also be invited to an on site review of our procedures and witness any or all sampling events. We will continually evaluate all data collected during the performance monitoring period. The principal investigator and QA manager will provide on-going assessments during actual operations and prepare performance reports after each sampling event.

A.9 Special Training Requirements / Certification

Some of the laboratory analyses and much of the field work on this project will be done by graduate students. Students working in the lab will be under the direct supervision of Mr. Xingyao Dai, a chemist with 11 years of commercial laboratory experience. Mr. Dai, now a research associate at La. Tech, is assisted by Ms. Hongjian Xiang, a graduate student who has been working with Dai for over a year. It is anticipated that each additional graduate student will be responsible for becoming competent in and conducting only one or two different analyses on all samples. Being responsible for a limited number of different analyses gives the students the best chance at becoming proficient and hopefully improves the quality of the resulting data. All test results will be subject to Dai's approval as well as all quality control criteria established for laboratory analyses. Mr. Dai and Ms. Xiang will handle or assist in handling the more difficult tests such as BOD. All analysts will be required to indicate in the appropriate logbook the specific test results they were responsible for producing.

Students working in the field will be under the direct supervision of Mr. Rishi Raj Bhattarai. "Raj" is a research associate at La. Tech with over 2 years experience in all aspects of sampling, sampler/flowmeter and rain gauge installation and operation. In addition Raj is knowledgeable in installing and using the software needed to download these devices. Students working in the field will be responsible for proper collection, labeling and transport of samples from the field to the lab. Any samples found to violate quality control restrictions will be flagged and/or discarded.

A.10 Documentation and Records

The Quality Assurance (QA) Officer will issue a quality assurance report describing the results of QC measurements for the monitoring project. Audit results will be summarized in the reports.

Reporting Procedures

One QA report will be issued for the project.

Report Content

The content and format for the Quality Assurance Reports are presented in the following outline:

QUALITY ASSURANCE REPORT

- 1.0 Summary of sampling and analytical activity and highlights of quality assurance results.
- 2.0 Measurement data accuracy, precision, and completeness (per method)
- 3.0 Significant quality assurance problems and recommended action

Two types of quality control results will be reported as appropriate for each sampling and analytical task:

Sampling Quality Control:

- Equipment blank analyses
- Field duplicate sample analyses

Analytical Quality Control

- Method spike analyses,
- Matrix spike analyses,
- Matrix spike duplicate analyses,
- Laboratory Check sample (LCS) analyses,
- LCS duplicate (LCSD) analyses,
- Reagent blank analyses, and
- Surrogate spike analyses

These data will be reported in tables by method.

Tables summarizing all QC data for the task will be prepared. The range of results for each type of data (blanks, spikes), the total number of samples, and number of acceptable

results will be indicated. Maximum laboratory turn around time will be equal to the maximum holding period for each test plus test time plus 3 days for entry of results into the data base. Difficulties during sampling will be documented by field personnel in field notebooks. Difficulties during analyses will be recorded in lab notebooks and transferred to the appropriate computer data base.

An evaluation of project data with regards to QC results will also be provided in the technical report. All records and documents related to this project will be retained by the Folk Lab for a minimum of 3 years.

Section B

B.1 Sampling Process Design

Current methods for treating runoff necessitate a consideration of nonpoint pollution control as well as flood control. In a state which receives as much rainfall as Louisiana it is difficult to discuss water quality without concerns about flood control and drainage. Current flood prevention measures generally rely on increasing the capacity of new or existing drainageways so as to remove larger quantities of water faster. There is an increasing realization that this approach simply moves the problem downstream rather than solve it.

Most nonpoint pollution control measures currently used have as their primary function drainage or flood control. Holding basins are designed to reduce the downstream flow rates by storing runoff. These basins can also remove contaminants by allowing them to settle and accumulate. However the degree to which such structures are successful in removing contaminants over extended periods has not been well documented. This project allows for a long-term quantitative examination and evaluation of the effectiveness of this management practice as a solution for the City of West Monroe.

The majority of samples to be collected during monitoring of the Black Bayou Watershed will be derived from rainfall and runoff samples. Discrete samples will be collected automatically over each runoff hydrograph at each major inlet and outlet to the basin. Concurrently flow and rainfall will be measured and the data logged. The samples will be stored in polypropylene containers under refrigerated conditions until retrieved. Depending on the tests to be run the sample containers may contain appropriate preservatives, (for example, acid to reduce pH) in order to increase acceptable holding times. Sampling equipment will sense and log the time at which samples are collected. Rainfall samples will be collected using atmospheric precipitation samplers. Samples will be retrieved and returned to the appropriate lab for analyses. Depending on available containers and conditions at the time of retrieval samples may be left in the original containers or transferred to different containers prior to transport. In all cases sample containers will be appropriately labeled prior to transport. Between sampling episodes, rainfall, and runoff storage containers will be washed with Bio-clean or similar detergent, rinsed with tap water and rerinsed with deionized or reagent grade water. Following the completion of analyses sample bottles will also be washed with detergent, rinsed with tap water, rerinsed with deionized or reagent grade water, and disinfected.

Samples will be collected upstream (inflow) and downstream (outflow) of the storm water detention basin. At the two locations, a determination will be made at the end of each storm event whether to use the sample for analyses. This determination will be based on the

size of the rainfall/runoff event and acceptability of the degree to which the resulting hydrograph has been "covered" by discrete sample collection.

The following activities further detail sampling methodology and procedures:

1. Delineate and measure the watershed from which runoff will enter the holding basin. A complete description of the types of land uses will be developed along with any historical significance the watershed area has.
2. Locate all inlets and outlets.
3. Install monitoring and sampling collection devices at the inlet and outlet points to monitor and log flow and collect samples
4. Locate rain gauges throughout the watershed to record and totalize rainfall, in order to allow a determination to be made of the incident rainfall that runs off the watershed and does not enter the storm water basin.
5. Each sampler should collect at least 5 discrete samples during each storm event, however this is subject to judgement.
6. All rainfall will be monitored for one year before the beginning of construction (Phase I) and one year after construction (Phase II) has been completed; and data will be collected for all rain fall events (an estimated 13 storm events per year).
7. Graph and tabulate data of pollutant flux for specified pollutants into and out of the basin.
8. Efficiency of the basin in removing a specific contaminant will be computed by the use of the following formula:

$$\text{Basin Efficiency} = (\text{Mass Entering} - \text{Mass Leaving}) / \text{Mass Entering}$$

The sampling program quality assurance plan will follow the EPA quality assurance plan for surface water monitoring and analysis. The laboratory which will do the analysis will be selected based upon its capacities to comply with the QAPP as set forth by EPA.

Hydrologic Models

Objective: To utilize two existing computer hydrologic models, HEC-1 and HEC-2, to generate runoff hydrographs for the contributing streams (HEC-1) and to predict the resulting water surface profiles for the 10-year, 50-year, 100-year, 500-year storm events.

Specific tasks to be completed in modeling include:

- i. Review previous hydrologic and hydraulic data, which has been collected during previous work that has been conducted within the watershed.
- ii. Utilize computer models generated during the most recent studies of the watershed for design and specification of the storm water detention basin.
- iii. Utilize HEC-1 to generate hydrographs for the feeding streams and generate flow for the 10-year, 50-year, 100-year, and 500-year storm event.
- iv. Utilize the HEC-2 model for hydraulic calculations to generate water surface elevations and velocities from the HEC-1 generated flow data.
- v. Modify the physical data of the HEC-1 model in order to provide final design configuration for the urban detention basin.
- vi. Utilize the HEC-1 model to regenerate flow for the entire Black Bayou watershed for the confirmation of the final water surface elevations by the HEC-2 program.
- vii. Recompute the water surfaces throughout the Black Bayou Drainage Basin to ascertain the flood control benefits derived from the proposed detention basin.
- viii. Determine the time required for the detention basin to complete its runoff through the controlled discharge outlet.

B.2 Sample Methods Requirements

The majority of samples collected during this study will be by automatic samplers. It is anticipated that the type of sampler used will be similar to the American Sigma, series 900. These samplers offer very flexible programming in order to provide a wide range of sampling scenarios. They can take up to 24 discrete samples as well as composite samples. Sampling can be initiated based on (1) flowrate, (2) water depth (3) elapsed time, (4) rainfall or a combination of these factors. The volume of sample collected is programmable and can be varied between sample containers within the same sampling event. The samplers have programmable pre and post air and water purge/rinse cycles to minimize cross contamination of samples. Sample collection times are logged and can be viewed or downloaded.

Sufficient containers for each sampler will be available so that each set may be removed, replaced with fresh containers and returned to the lab. Once sample containers are empty they will be disinfected and cleaned by soaking in a bleach/lab detergent mixture, rinsed using tap water until all traces of detergent are removed and a final rinse in distilled water. To the maximum extent possible sample preservation methods and holding times summarized in Table 1060:I of Standard Methods (Standard Methods, 1992, pg 1-22) will be adhered to. Deviations from these requirements will be noted in collection and login records. The P.I. and laboratory director are responsible for seeing that samples are collected in properly cleaned containers. Hazardous waste products such as spent reagents and cleaning solutions will be disposed of by personnel from the hazardous waste disposal office at Louisiana Tech University.

Equipment Failure

Persons responsible for collecting samples will also inspect samplers for proper operation at each visit. If necessary, any batteries powering the sampler or auxiliary equipment will be replaced on a regular schedule. Should problems occur the individual responsible for sample collection will attempt to correct them. If this is not possible the problem will be reported to the P.I. or one of the research associates on this project who will attempt to repair the malfunction. Should this not be possible the instrument will be returned to the manufacturer for immediate repair. A loaner will be obtained from the local distributor as soon as possible. All pertinent information regarding the failure will be recorded for reference.

Table B.2.1
Sample Storage and Preservation Requirements

Parameter	Analysis Method	Holding Time	Containers [Bottles]	Preservation	Storage Requirements
Coliform, fecal and total	SM 9222D/9222B	6 hours	100-ml Sterile glass or plastic	None	4 degree C
Ammonia	4500 - NH ₃ B 4500 - NH ₃ E HACH - Method 8038	28 days	P, G	add H ₂ SO ₄ pH < 2	4 degree C
Total Kjeldahl nitrogen (TKN)	SM 4500orgB or 4500orgC	28 day	500-ml polypropylene	add conc. H ₂ SO ₄ pH < 2	4 degree C
Nitrate nitrogen (NO ₃ -N)	SM 4500-NO ₃ E.	28 day	500-ml polypropylene	add conc. H ₂ SO ₄ pH < 2	4 degree C
Total Phosphorus (P)	SM 4500-P B. and SM 4500-P F.	N/A	P, G	add HCL pH < 2	-10 degree C
BOD ₅	SM 5210 B	48 hrs	P, G	refrigerate	4 degree C
COD	HACH method 8000	28 days	P, G	refrigerate add HCL pH < 2	4 degree C
TSS	SM 2540 D	7 days	P, G	refrigerate	4 degree C
Chlorophyll	SM 10200 H	30 days in dark	P, G	darkness	N.A.
Oil and Grease	SM 5520 C	28 d	G	add HCL pH < 2	N.A.
Alkalinity	SM 2320 B	14 days	P, G	refrigerate	4 degree C
Hardness	SM 2340 C	6 mo	P, G	add HNO ₃ pH < 2.0	N.A.

Parameter	Analysis Method	Holding Time	Containers [Bottles]	Preservation	Storage Requirements
pH	SM 4500-H ⁺ B	on-site	N.A.	None	N.A.
Dissolved oxygen	4500 - O G	on-site	N.A.	None	N.A.
Conductivity	SM 2510 B	28 day	N.A.	None	4 degree C
Temperature	SM 2550 B	on-site	N.A.	None	-
Arsenic (Ar)	SM 3120 B	6 mo	500-ml polypropylene	add HNO ₃ pH <2	4 degree C
Aluminum (Al)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Chromium (Cr)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Iron (Fe)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Copper (Cu)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Manganese (Mn)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Zinc (Zn)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C
Cadmium (Cd)	SM 3120 B	6 mo	P, G	add HNO ₃ pH <2	4 degree C

Parameter	Analysis Method	Holding Time	Containers [Bottles]	Preservation	Storage Requirements
Lead (Pb)	SM 3120 B	6 mo	P, G	add HNO ₃ pH < 2	4 degree C
Mercury (Hg)	SM 3500 Hg B	28 d	P(A), G(A)	add HNO ₃ pH < 2	4 degree C
Nickel (Ni)	SM 3120 B	6 mo	P, G	add HNO ₃ pH < 2	4 degree C

B.3 Sample Handling and Custody Requirements

Sample Collection and Preservation

Introduction

Difficulties can arise regarding holding times and appropriate sample preservation during nonpoint studies because of :

1. Length of the storm event relative to allowable holding times
2. Time required to retrieve samples once an event has occurred
3. Number of samples, sample size, container type and preservative requirements for various analytical tests.

It does not appear practically possible to completely reconcile all of these various requirements. In this study refrigerated samplers will be used to reduce the temperature of collected samples to less than 4° C. At this point it appears that the most feasible type of sample containers for use in the samplers are 1 liter polypropylene containers. These can be used in lots of 24 in the samplers. While glass containers are available they were found to be too small (350 ml.) to collect adequate sized samples or so large (1.9 liter) that only 8 could be used in a sampler at once. Once samples are retrieved, appropriately sized aliquots will be placed in glass or polypropylene containers as required and the necessary preservatives added (Table 1060-I, Standard Methods, 1992). Samples will be stored in insulated coolers with ice for transport to the appropriate laboratory (Folk Lab or American Interplex). Every effort will be made to minimize the time between the occurrence of a storm event and sample retrieval. Sample collection and arrival times will be documented.

Sample Handling and Custody Requirements

Sample possession during all sampling efforts must be documented from the time of collection until sample results are verified and reported. Sample custody procedures will provide a mechanism for documentation of all information related to sample collection and handling. These procedures will also be applied to samples sent to American Interplex labs for metals analyses. In addition American Interplex maintains their own comprehensive set of chain-of-custody procedures.

Sample Labels

Each sample container will receive a sample label. Every sample container will be labeled with the project title (West Monroe), source of the sample (inlet sampler), person collecting sample, date, time, sample collection number (1-24), preservative added. Writing instruments shall use indelible ink, not subject to running. Labels shall be of a type that is waterproof yet removable (See 1997 Fisher Scientific Catalogue for examples). If a sample is split between containers ALL information on the original label shall be put on subsequent container labels as well as any additional preservatives added (i.e. HCL). New labels will be affixed to all sample bottles each time they are used. Previous labels will be removed. Information may not be crossed out in order to reuse labels as this practice causes confusion.

Field Records

Graduate students who have the responsibility of retrieving samples shall maintain field log books. They will record the time and date of each visit. Names of person(s) visiting the site, site condition, observations regarding samplers and samples and any other unusual conditions. All entries will be legible, written in waterproof ink, and contain documentation of an individual's field activities, including field data and observations, any problems encountered, and actions taken to resolve the problem. Entry errors or changes will be crossed out with a single line, dated and initialed by the person making the correction. Entries made by individuals other than the person to whom the logbook was assigned will be dated and signed.

Laboratory Procedures - Folk Lab

Samples returned to the Folk Memorial Laboratory will be logged-in in a separate notebook maintained for each project. Login information will include responsible individual, location, date and time of collection, date and time of return to the lab, sample number, container type, preservatives added, tests to be run, and storage location in the lab.

Laboratory Personnel

At present Folk Laboratory personnel consist of the following:

Xiang Dai M.S. - Laboratory Director / Research Associate, responsible for day to day

operation of the lab, training of research assistants, maintenance of acceptable QA/QC .

Rishi Raj Bhatteai, M.S. - Research Associate, overall responsibility for the project field work and equipment maintenance, data manipulation and analyses (MATHCAD)

Hongjian Xiang, B.S. - Graduate research assistant, responsible for COD testing, data base maintenance on computer spread sheets, (EXCEL,AXUM). Data manipulation and analyses.

Sashi Shretha, B.S. - Graduate research assistant, responsible for sample collection, TSS and VSS analyses.

Mehran Eslami, B.S. - Graduate research assistant, responsible for sample collection, TSS and VSS analyses

Derrick Roberson, E.I.T. - Undergraduate, responsible for keeping laboratory clean, washing glassware and plastic ware.

D. M. Griffin, Jr., PH.D., P.E. - Principal Investigator, overall project responsibility, budget responsibility, purchasing responsibility, washing glassware and plastic ware.

Ms. Karen Cummings, B.S. - City of West Monroe, responsible for sample collection, laboratory work, QA/QC

It is anticipated that within the next 6 months 2 of the research assistants will graduate and be replaced by others.

Chain of Custody- La. Tech

Sample possession during all sampling efforts must be traceable from the time of collection until the results are verified and reported. The sample custody procedures must provide a mechanism for documentation of all information related to sample collection and handling to achieve this objective. For this project all samples will be collected by La. Tech City of West Monroe personnel and many of the tests will be run in the Folk Lab at Louisiana Tech. Thus, only La.Tech personnel will have custody of samples from collection until many of the results are reported. In such instances chain of custody information will be recorded in existing field and laboratory notebooks. In those cases where samples are subcontracted to American Interplex Labs for analyses such as in the case of metals, proper custody and documentation procedures for all sampling will be adhered to for sampling operations. Chain-of-custody forms will be used as the primary documentation mechanism to ensure that all information pertaining to each sample id is recorded. American Interplex maintains a comprehensive chain of custody procedure. In addition, field notebooks and sample log will be maintained for all samples collected during each sample collection activity. Copies of the chain-of-custody forms and the field logs will be retained in the project file.

All sample shipments to American Interplex will be accompanied by a chain-of-custody record, which identifies its contents. The original record, plus copies will accompany the shipment with one copy retained in the project file. Another copy will be returned to the project team with analytical results, and the original returned when the sample is disposed. When samples are split for duplicate analysis, a separate chain-of-custody record will be prepared. The person relinquishing the samples to the facility or agency will request the signature of a representative to acknowledge receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received By" space. When appropriate, as in the case of overnight shipment, the custody record should contain a statement that the samples were delivered to the designated location and the date and time noted. Sample collection and shipment will be coordinated to ensure that the receiving laboratory has staff available to process the sampling according to method specifications. All shipping containers will be secured with chain-of-custody seals for transportation to the laboratory. The method of shipment, courier name(s), and other pertinent information is entered in the "Remarks" section when the samples are to be shipped instead of hand delivered.

Shipping Procedures

The objective of sampling procedures is to ensure that samples arrive at the laboratory intact, at the proper temperature, and free of external contamination. If not hand delivered, all samples will be shipped to the analytical services laboratory via overnight carriers, according to Department of Transportation standards. Chain-of-Custody procedures will be followed during transport.

When samples are required to be stored at temperatures of 4 degrees C or less, generous amounts of bagged ice will be packed with the samples. The ice will be of sufficient volume and will be distributed in the coolers so that the proper storage temperature will be maintained until the samples reach the laboratory without freezing the samples. Small, commercially available, thermometers will be placed in each cooler. When the samples are delivered to the laboratory, the temperature of each cooler of samples will be measured and recorded on the chain-of-custody form or addendum. Any samples which are frozen will be noted. The samples will be immediately placed in a sample control refrigerator after sample log-in.

Chain of Custody Record

The following procedures will be used to prevent bottle breakage and cross-contamination: All samples will be transported inside hard plastic coolers; vermiculite or absorbent paper will be used to isolate the bottles from each other; and the coolers will be

taped shut and sealed with tape. Samples sent to American Interplex Labs will conform to their chain of custody procedures.

Outside Laboratory Operations

Tests for metals and organics will be carried out by American Interplex laboratories in Little Rock Arkansas. The P.I., lab director and quality assurance officer for this project have visited this laboratory and had discussions with the Lab director, chief operating officer and quality assurance officer. This lab follows a well documented set of standard operating procedures for sample handling, identification, control and chain of custody in order to assure the quality and validity of results. The SOPS are based on use of a computerized laboratory tracking and information system developed in-house. Samples are tracked from receipt until results are reported. Quality assurance data bases are automatically updated upon entry of laboratory results by the analyst. Violations of quality assurance parameters are flagged and automatically sent to the quality assurance officer for appropriate action.

B.4 Analytical Method Requirements

This section contains brief descriptions of calibration procedures and analytical methodology for the analysis of water samples collected during the monitoring of the storm water detention basin demonstration project for runoff and infiltration effluents.

B.4.1 Identification of Methods

Methods to be used for sample analysis are presented in Table B.4.1. Most of the laboratory methods identified in this document were published in **Standard Methods for Examination of Water and Wastewater**, 18th Edition, United States Environmental Protection Agency (US EPA, 1986) **Test Methods for Evaluating Solid Waste, Physical Waste, Physical/Chemical Methods SW846**, Third Edition, or **Methods for Chemical Analysis of Water and Wastes** (US EPA 1983). Additional methods were published in "Criteria for Identification of Hazardous and Extremely Hazardous Wastes," "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR, part 136, Federal Register 49 (209), 26 October 1984,].

B.4.2 Method Detection and Quantification Limits

This section presents and defines limits to be used in describing detectable concentrations.

Terminology

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero.

Procedures

The laboratory will perform MDL studies on an annual or quarterly basis (depending on the method) to determine that it can meet or exceed the method recommended MDL's. The U. S. EPA procedure used for establishing MDL's is described in Appendix B to Part 136 "Definition and Procedure for the Determination of the Method detection Limit" - Revision 1.11, 40 CFR 136, 1986. This procedure consist of analyzing (using all sample processing steps specified in the method) seven aliquots of a standard spiked at three to five times the expected MDL. The MDL is defined as three

Table B.4.1
Analytical Methods to be Used for West Monroe Urban Detention Basin Study

Parameter	Analysis Method*
Coliform, fecal and total	SM 9222D/9222B
Total Kjeldahl Nitrogen [TKN]	SM 4500orgB or 4500orgC
Nitrate-Nitrogen [NO ₃ -N]	SM 4500-NO ₃ E.
Ammonia - Nitrogen [NH ₃ -N]	SM 4500 NH ₃ E
Phosphorus [P]	SM 4500-P B. and 4500-P F.
COD	HACH method 8000
BOD ₅	SM 4500-SO ₄ ²⁻ -F.
TSS	SM 2540 D
Chlorophyll	SM 10200 H
Oil and Grease	SM 5520 C
Alkalinity	SM 2320 B
Hardness	SM 2340 C
pH	SM 4500-H+ B
Dissolved oxygen	SM 4500-O G
Temperature	SM 2550 B
Arsenic [Ar]	SM 3120 B
Aluminum [Al]	SM 3120 B
Chromium [Cr]	SM 3120 B
Iron [Fe]	SM 3120 B
Copper [Cu]	SM 3120 B
Manganese [Mn]	SM 3120 B
Zinc [Zn]	SM 3120 B

Cadmium [Cd]	SM 3120 B
Mercury [Hg]	SM 3500 Hg B
Lead [Pb]	SM 3120
Nickel [Ni]	SM 3120

*Standard Methods (SM) For The Examination Of Water And Wastewater, 18th Ed., 1992.

(3.14) times the standard deviation of the mean value for the seven analyses. In addition, the laboratory may establish reporting limits which are verified by the MDL studies and included on the laboratory's analytical reports. Corrective actions for each analytical method are described in Section B, Table B.5.2.

B.5 Internal Quality Control Checks

Internal quality control (QC) is achieved by collection and/or analyzing a series of duplicate, replicate (more than 2), blank, spike and spike duplicate samples to ensure that the analytical results are within quality control limits specified by the program. Laboratory QC samples are documented at the lab bench and reported with the analytical results. The QC sample results are used to quantify precision and accuracy and to identify problems or limitations associated with sample results. The procedures and equations for computing QC statistics are provided in Section D.2.

Field Quality Control

Field QC samples will be documented in field logbooks and submitted blind to the lab in such a way that lab personnel cannot distinguish between natural and QC samples during analysis. This process assures that objective data of known quality are produced throughout the monitoring program.

Field Duplicate Samples (replicates)

A field duplicate is a second sample collected at the same point and in the same way as the original sample. Field duplicates are used to assess precision, including variability associated with both lab procedures and sampling collection. In this project field duplicate samples may not be useful since the various sampled waste streams change over time. In some cases (pump station discharge) waste characteristics may change on the order of 100% or more in the several seconds between successive samplings. Thus, results of duplicate samples may incorrectly indicate significant imprecision. When used, field duplicates will be obtained by collecting a single sample and then splitting it into 2 or more replicates at the point of collection. Each replicate will be stored and transported in an identical manner.

Equipment Blanks

Equipment blanks consist of reagent water or organic free water poured into the sampling device or sample bottle and transported "blind" to the lab for analysis. The collection frequency for equipment blanks will be 5%.

Laboratory Quality Control

Laboratory QC is necessary to control analytical procedures, to assess the accuracy and precision of analytical results, and to identify causes for atypical results. QC checks in the lab are specific to the analytical method and generally include the use of the following types of QC

samples as appropriate (for instance there is no generally accepted laboratory check sample for TSS or VSS analysis).

Calibration Standards

Initial calibration is performed as required for each analytical method requiring calibration; for instance, those requiring the use of a spectrophotometer. A range of calibration standards is employed with the low standard near the detection limit of the instrument. This procedure is used to establish the linear response range of the procedure. From such results a calibration curve can be constructed. Calibration for each method is discussed in section B.7. Meters equipped with manual or automatic calibration procedures (i.e. pH meters) shall be calibrated using a two point procedure prior to each use.

Laboratory Check Samples

Laboratory check samples (LCS) are quality control check solutions containing the compound of interest at a known concentration, usually in the mid calibration range. The samples are used to demonstrate that the method and instrument are operating within acceptable tolerances. LCSs are required for each analytical procedure where they are available (not available for fecal coliforms, TSS, VSS and possibly other tests). In instances where lab check samples are not available blanks may serve this purpose.

Reagent Blank

A reagent blank is a sample composed of all the reagents in the same quantities used in preparing the sample for analysis. It is carried through the same preparation steps as the sample. Reagent blanks are used to insure that interferences from the analytical system, reagents and glassware are within acceptable limits. The frequency for analyzing reagent blanks is one per test batch.

Matrix Spike/ Matrix Spike Duplicates

A matrix spike is a solution of the target analytes at known concentrations that is spiked into a field sample before sample preparation and analysis. Two aliquots of the sample are spiked for duplicate analysis. The results of the duplicate spikes are used to measure the percent recovery of each spiked compound and compare the recovery between samples. This provides an estimate of both the accuracy and precision of the method. The frequency for matrix spike analysis is 5% for all tests where matrix spikes are used. In this project matrix spikes will be used for information purposes only.

Laboratory Duplicates (Duplicate analysis)

Lab duplicates are repeated but independent determinations on the same sample, by the same analyst, at essentially the same time and under the same conditions. The sample collected is split in the lab and each aliquot is carried through all stages of preparation and analysis. This provides an estimate of the precision of the analytical method. Duplicates are performed on at least 10% of all samples.

Control Limits

Control limits and acceptance criteria for QC samples are presented by method in Table B.5.1 and B.5.2, respectively. The corrective activities listed are to be used as guidelines and not necessarily followed in the exact order listed. The primary intent of these guidelines are to provide a rational procedure for identifying and correcting analytical problems before proceeding to analyze additional samples.

Table B.5.1
Quality Control Acceptance Criteria

	Matrix Spike	Low Level Duplicates	High Level Duplicates	LCS Spike
Parameter	Accuracy	Precision	Precision	Accuracy
	(% Recovery)	±%	±%	±%
Coliform, fecal and total SM 9222D / 9222B	N.A.	N.A.	N.A.	N.A.
Total Kjeldahl Nitrogen (TKN) SM 4500orgB/4500orgC	80 to 120	25	10	NA
Nitrate Nitrogen (NO ₃ -N) SM 4500-NO ₃ E	80 to 120	25	10	10
Ammonia SM 4500 - NH ₃ B@E HACH Method 8038				
Phosphorous (PO ₄ ³⁻) SM 4500-P-F	80 to 120	25	10	10
BOD ₅ SM 5210 B	80 to 120	25	20	10
COD HACH 8000, SM 5220 D	80 to 120	25	10	10
TSS SM 2540 D	80 to 120	25*-100	10	10
Chlorophyll SM 10200 H	80 to 120	25	10	10
Oil and Grease SM 5520 C	80 to 120	25	10	10
Alkalinity SM 2320 B	80 to 120	10	10	10
Hardness SM 2340 C	80 to 120	10	10	10
pH SM 4500-H ⁺ B	80 to 120	5	5	10

Dissolved Oxygen SM 4500 - O G	80 to 120	10	10	10
Conductivity SM 2510 B	80 to 120	5	5	5
Temperature SM 2550 B	80 to 120	N.A.	N.A.	N.A.
Arsenic [Ar] SM 3120B (ICP)	80 to 120	25	25	10
Aluminum [Al] 3120B (ICP)	80 to 120	25	25	10
Manganese [Mn] SM 3120B (ICP)	80 to 120	25	25	10
Iron [Fe] SM 3120B(ICP)	80 to 120	25	25	10
Copper [Cu] SM 3120B(ICP)	80 to 120	25	25	10
Chromium SM 3120B(ICP)	80 to 120	25	25	10
Zinc [Zn] SM 3120B(ICP)	80 to 120	25	25	10
Cadmium [Cd] SM 3120B(ICP)	80 to 120	25	25	10
Mercury [Hg] SM 3120B(ICP)	80 to 120	25	25	10
Lead [Pb] SM 3120B(ICP)	80 to 120	25	25	10
Nickel [Ni] SM 3120B(ICP)	80 to 120	25	25	10

*below 10 mg/l, precision requirements for duplicates are plus/minus 1 mg/l

Table B.5.2
Summary of Calibration and Internal Quality Control

Parameter	Analysis Method	Quality Control Check	Minimum Frequency	Acceptance Criteria	Correction
Coliform, fecal	SM 9222D	Method Blank	Daily	0 CFU/ml	Will be used to determine sterility of reagents
Total Kjeldahl nitrogen (TKN)	SM 4500orgB or 4500orgC	Duplicate Analysis	All Samples	NA	Will be used to determine analytical variability
		Method Blank	1 each sample set	NA	Will be used to correct results
		Duplicate Sample	10%	RPD $< \pm 10\%$	Flag data, obtain third value
Ammonia Nitrogen	SM 4500 NH ₃ E	Method Blank	each set	RPD $< \pm 10\%$	Will be used to correct results
		Duplicate Sample	10%	RPD $< \pm 10\%$	Flag data, obtain third value
Nitrate nitrogen (NO ₃ -N)	SM 4500-NO ₃ D	Standard Solutions	1 each sample set	RPD $< \pm 10\%$	Recheck Calibration Service Equipment
		Duplicate Sample	10%	RPD $< \pm 10\%$	Flag data, obtain third value
Phosphorous (P)	SM 4500-P B. and SM 4500-P F.	Standard Solutions	1 each sample set	RPD $< \pm 10\%$	Recheck Calibration Service Equipment
		Duplicate Sample	10%	RPD $< \pm 10\%$	Flag data, obtain third value

Table B.5.2 (continued)
Summary of Calibration and Internal Quality Control

Parameter	Analysis	Quality Control Check	Minimum Frequency	Acceptance Criteria	Correction
BOD ₅	5210 B	Glucose/Glutamic Acid check solution	1 each sample set	198 mg/L, ± 30.5 mg/l	check procedure, equipment
		replicates	each sample	RPD $< \pm 10\%$	flag data
COD	HACH 8000	HACH Standard Solutions	10%	RPD $< \pm 10\%$	check equipment, procedure
		replicates	1 each set	RPD $< \pm 10\%$	check equipment, procedure, reanalyze, flag data
TSS	2540 D	replicates	1 each sample set	RPD $< \pm 10\%$	check equipment, procedure, reanalyze, flag data
chlorophyll	10200 H	replicates	1 each sample set	RPD $< \pm 10\%$	check equipment, procedure, reanalyze, flag data
Conductivity	2510 B	replicates	1 each sample set	RPD $< \pm 10\%$	check equipment, procedure, reanalyze, flag data

Table B.5.2 (continued)
Summary of Calibration and Internal Quality Control

Parameter	Analysis	Quality Control Check	Minimum Frequency	Acceptance Criteria	Correction
Alkalinity	2320 B	replicates	1 each sample set	RPD < \pm 10%	check equipment, procedure, reanalyze, flag data
Hardness	2340 C	replicates	1 each sample set	RPD < \pm 10%	check equipment, procedure, reanalyze, flag data
pH	4500-H+ B	on-site	N.A.	RPD < \pm 10%	check equipment, procedure, reanalyze, flag data
Dissolved oxygen	4500-O G	on-site	N.A.	N.A.	calibrate equipment
temperature	2550 B	on-site	N.A.	N.A.	calibrate instrument
Oil and Grease	5520 C	replicates	1 each sample set	RPD < \pm 10%	Recheck calibration, service equipment, reanalyze, flag data

B.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The primary objective of a preventive maintenance program is to promote the timely and effective completion of the sampling and analysis effort. Preventive maintenance is designed to minimize down time of critical equipment due to expected as well as unexpected failures. In implementing this type of program for the Black Bayou Watershed, efforts are focused in three areas:

1. Establishment of equipment maintenance responsibilities;
2. Establishment of maintenance schedules for major/critical instrumentation and
3. Establishment of an adequate inventory of spare parts and equipment as well as procedures for obtaining loaner equipment if needed

Responsibilities and Procedures

For this project, preventive maintenance of equipment used in the field (samplers, flow meters, rain gauges) is the joint responsibility of Folk Lab personnel at Louisiana Tech University and the City of West Monroe.

Maintenance of on site, laboratory instrumentation is the responsibility of the director of the Folk Laboratory at Louisiana Tech University. Maintenance of laboratory equipment used by outside labs contracted for analysis is the responsibility of the lab director for that facility.

Maintenance Schedules

Maintenance schedules for field equipment are based on manufacturers recommendations as well as the experience of the field personnel responsible for the equipment. Maintenance schedules for Folk lab instrumentation is the responsibility of the lab director. Maintenance schedules for contract lab equipment is the responsibility of the lab director for that facility. Spare parts and backup instrumentation will be maintained to the maximum extent possible.

B.7 Instrument Calibration and Frequency

This section describes each analytical method and corresponding calibration information used for the storm water detention basin demonstration project.

Laboratory Methods:

Method SM 5210 B Biochemical Oxygen Demand

The BOD test consists of incubating a waste sample mixed with dilution water at 20 C in the dark for a period of 5 days. The dissolved oxygen content of the mixture is measured before and after the incubation period. The dissolved oxygen used, corrected for dilution, is computed and expressed as mg/l BOD₅. The D.O. meter used is calibrated before each use and the membrane changed every 2 weeks or sooner. During measurements if meter readings are found to drift the meter and/or probe is sent for maintenance. All meters and probes are returned to YSI for routine maintenance once each year.

Method SM 5220, HACH Method 8000 Chemical Oxygen Demand

A sample of waste is mixed with potassium dichromate in an acid environment in a sealed tube. The mixture is heated during which time the dichromate oxidizes organics in the sample to CO₂ and water. In the HACH procedure the equivalent amount of oxygen used is determined by measurement against standards at either 420 nm (low range) or 620 nm (high range). Results are expressed as mg/l COD. Prior to use the spectrophotometer is calibrated against known standards.

Method SM 2540 D Total Suspended Solids

A sample of known volume is passed through a glass fiber filter. The filter is dried to a constant weight at 103 to 105 C°. The increase in weight of the filter is taken to be the total suspended solids concentration of the sample. Results are reported as mg/l total suspended solids. The balance used is calibrated before each use. Precision requirements for duplicate analyses are plus/minus 10 % unless the concentration of TSS is below 10 mg/l; in which case the precision requirement is plus/minus 1 mg/l

Method SM 9222D/9222B
Coliform, fecal

The levels of coliform bacteria will be assessed by filtration/plate count techniques. The basic procedure involves filtration of a known volume of sample through a filter which traps microorganisms. The filter is then placed in a petri dish with media selective for fecal coliforms and incubated. Colony counts are then made, corrected for dilution and reported as colonies per 100 ml of sample. Incubation of plates takes place in a water bath with continuous digital temperature readout. A thermometer will also be used in the water bath to confirm temperature.

Method SM 4500orgB/4500orgC
Total Kjeldahl Nitrogen (TKN)

The concentration of nitrogen in organic forms will be assessed by macro- or semi-macro kjeldahl method following SM 4500orgB or SM 4500orgC, respectively. The basic method involves digestion of a sample of known volume in the presence of sulfuric acid, potassium sulfate, and mercuric sulfate catalyst to convert free ammonia, ammonium-nitrogen, and amino nitrogen of organic materials to ammonium sulfate. During sample digestion, a mercury ammonium complex is formed and then decomposed by sodium thiosulfate. After decomposition the ammonia is distilled from an alkaline medium and absorbed in boric or sulfuric acid. The ammonia is determined colorimetrically or by titration with a standard mineral acid. Samples containing <4mg organic nitrogen/L must follow the macro-kjeldahl method.

Method SM 4500-NO₃ E
Nitrate Nitrogen (NO₃-N)

The method involves measurement of nitrate using a commercially available electrodes.

Method SM 4500 NH₃ - E HACH Method
Ammonia [NH₃]

Method SM 4500 -O G
Dissolved oxygen

This method involves the use of commercially available dissolved oxygen meters. Meters are air calibrated before each use. Membranes are changed at least every 2 weeks.

Method SM 2340 C
Hardness

EDTA forms a soluble chelated complex when added to solutions containing metal ions. If a small amount of Erichrome Black T dye is added to an aqueous solution containing Ca and Mg ions the solution turns wine red. If EDTA is then used as a titrant the Ca and Mg will be complexed. When all of the Ca and Mg have been complexed the color of the solution changes from wine red to blue.

Method SM 3030 H / SM 3120 B
Arsenic (Ar), Aluminum (B), Cadmium (Cd), Copper (Cu), Iron (Fe), Lead (Pb), Manganese (Mn), Nickel (Ni), Mercury [Hg], Chromium [Cr], and Zinc (Zn)

The concentrations of the metals listed above will be assessed following method SM 3030 H and 3120 B, respectively. The basic method requires preliminary treatment of samples containing particulates or organic material prior to the determination of "total metals", which includes all inorganically and organically bound metals. The preliminary treatment involves digestion of a known sample volume in the presence of nitric acid and perchloric acid; method SM 3030 H. Following the digestion procedure, metal concentrations are determined by the Inductively Coupled Plasma (ICP) method; SM 3120 B. The analyses will be performed by American Interplex Laboratories, Little Rock, Arkansas which maintains a complete QA/QC program.

Calibration Procedures and Frequency For Field Test Equipment:

Calibration procedures for field and laboratory instrumentation are performed to ensure that the instruments are operating properly and produce data that can satisfy the objectives of the sampling program.

The instruments to be used in the field during the project are listed below:

Automatic Rain Gauges;

Automatic Flow Meters;

Automatic Refrigerated Samplers

The on site stationary instruments will be calibrated according to the manufacturers' specifications by factory trained personnel following on site installation prior to sample acquisition. Factory trained personnel will instruct City of West Monroe personnel on procedures required for maintaining instruments within manufacturers' specifications. Instruments will be serviced and recalibrated at intervals recommended by manufacturer. The portable instruments will be serviced and/or recalibrated at intervals recommended by the manufacturer.

The rain gauge, flow meter, and refrigerated sampler will be stationary on site. The instruments will be line powered, and interconnected for monitoring rainfall, runoff low, and runoff effluent sample collection.

Tipping Bucket / Totalizing Rain Gauge

A stationary "tipping bucket" rain gauge will be used for determining the amount rainfall (to .01 inch or 0.1 mm rainfall). The instrument will be calibrated according to the manufacturer's specifications by factory trained personnel following on site installation prior to sample acquisition. Factory trained personnel will instruct City of West Monroe personnel on procedures required for maintaining the instrument within manufacturer's specifications. The instrument will be serviced and recalibrated at intervals recommended by manufacturer.

Automatic Flow Meter

A stationary flow meter will be connected to the rain gauge. A variety of different ways of triggering the sampler are possible and the exact procedure may be varied once testing starts. The rain gauge will activate operation of the flow meter when a rainfall event of 0.5 inch has occurred. The flow meter will have an attached velocity probe that measures liquid velocity directly using the Doppler. The instrument will be calibrated according to the manufacturer's specifications by factory trained personnel following on site installation prior to sample acquisition. Factory trained personnel will instruct City of West Monroe personnel on procedures required for maintaining the instrument within manufacturer's specifications. The instrument will be serviced and recalibrated at intervals recommended by the manufacturer (every 6 months).

Automatic Refrigerated Sampler

A stationary refrigerated composite sampler will be connected to the flow meter. The sampler can be triggered to collect samples based on a variety of occurrences, ranging from a preset flow rate or cumulative volume to a preset rainfall amount. The sampler will employ a peristaltic pump with attached suction tubing. The pump will lift 1 ml of effluent per minute (10 to 9990 ml in 1 ml increments automatically with a sample volume repeatability of ± 10 ml) and deposit the effluent into a collection container for the duration of the runoff stream flow event. The sampler will be capable of pre and post purge capabilities using either air or water to prevent contamination. The collection container will be housed in a refrigerator. The refrigerator will be operated at a set point of 39 degree F. Sample set point accuracy will be ± 1.8 degree F at 39 degree F. The instrument will be calibrated according to the manufacturer's specifications by factory trained personnel following on site installation prior to sample acquisition. Factory trained personnel will instruct City of West Monroe personnel on procedures required for maintaining the instrument within manufacturer's specifications. The instrument will be serviced and recalibrated at intervals recommended by manufacturer. All collection containers to be used for collecting the composite sample will be washed with Bio - Gard or similar detergent, rinsed thoroughly with deionized or reagent grade water, and air-dried prior to use for each rainfall event.

B.8 Inspection/Acceptance Requirements for Supplies and Consumables

Field sampling equipment will be inspected at each visit and supplies will be inspected on each day of use by Folk lab personnel. This includes sample containers, preservatives, filters and reagents. The lab director is responsible for maintaining sufficient stocks of consumable supplies to avoid delays and holding time violations.

B.10 Data Management

The primary data management activities for the storm water detention basin demonstration project will include:

Data management to ensure that data are stored and output in a manner that continues the chain-of-custody;

Requirements review to ensure that plans for data collection were fulfilled, Analytical and field data validation and reporting for system evaluation, and

Reporting functions which may include out-putting data for report tables, statistical analysis and storm water detention basin use performance evaluation.

City of West Monroe and La.Tech personnel will be responsible for field data collection and transferring samples to the testing laboratory. All field data will be recorded in a numbered laboratory notebook with each page signed and dated by the person recording the information. Field data will be transferred to a computerized data base (EXCEL) for ease of management, report and graphic preparation. The data base will be maintained on at least one computer which is backed up (tape backup) on a weekly basis. All original written records will be retained.

Section C

C.1 Assessments and Response Actions

Assessments

A quality assurance (QA) audit is an independent appraisal of a measurement system. It typically includes a performance evaluation using apparatus and/or standards that are different from those used in the measurement system. It may also include an evaluation of the potential of the system to produce data of adequate quality to satisfy the objectives of the measurement effort. The independent, objective nature of the audit requires that the auditor be functionally independent of the sampling/analytical team.

Quality assurance audits play an important role in an overall QA/QC program. This section describes the role of the QA auditor, and the nature of both systems and performance audits.

Quality Assurance Auditor

The QA auditor is the person who designs and/or performs QA systems and performance audits. Since QA audits represent, by definition, independent assessments of a measurement system and associated data quality, the auditor must be functionally independent of the measurement effort to ensure objectivity. The auditor must be experienced in the objectives, principals and procedures of the measurement effort to perform a thorough and objective evaluation of the measurement system. The auditor's technical background and experience provide a basis for appropriate audit standard selection, audit design and data interpretation. Especially important is the ability to identify components of the system that are crucial to overall data quality, so that the audit focuses heavily upon these elements. The auditor also must have writing skills sufficient to clearly document the findings and recommendations of the audit. The function of the QA auditor is to:

- Observe procedures and techniques in use in the various measurement efforts, including field sampling and analysis;

- Check and verify instrument calibration records;

- Assess the effectiveness of and adherence to prescribed QC procedures;

- Review and document control and chain-of-custody procedures;

Identify and correct weaknesses in the sampling/analytical approach and techniques;

Assess the overall data quality in the various sampling/analytical systems;

Challenge the various measurement systems with certified audit standards;

For this project the lab director and the P.I. will, at times, carry out the function of an auditor. Presumably DEQ and/or EPA may wish to send an auditor to either the Folk Lab at Louisiana Tech or to American Interplex. The P.I. may request an audit prior to beginning this project in order to assure that lab procedures are satisfactory.

Technical Systems Audit

A technical systems audit (TSA) is a qualitative review of the various aspects of a total sampling and/or analytical system to assess its overall effectiveness. It represents an objective evaluation of a set of interactive systems with respect to strengths, weaknesses, and potential problem area. The audit provides an evaluation of the adequacy of the overall measurement system(s) to provide data of known quality that are sufficient, in terms of quality and quantity to meet the program objectives.

The technical systems audit consists of observations and documentation of all aspects of the sampling and analytical activities. Checklists that delineate the critical aspects of each methodology are used by the auditor to serve and document all observations. In addition to evaluating sampling and analytical procedures and techniques, the systems audit emphasizes review of all record keeping and data handling systems including:

Calibration documentation for analytical instrumentation and sampling apparatus;

Documentation of quality control data (control charts, etc);

Completeness of data forms and notebooks;

Data review and validation procedures;

Data storage and filing procedures;

Sample logging procedures;

Chain-of-Custody procedures;

Documentation of maintenance activities; and

Review of malfunction reporting procedures.

Performance Audit

A performance audit is an independent check to evaluate the data produced by a measurement system. Audit standards and test equipment which are traceable to acceptable reference standards are used to assess the performance of each analytical method and measurement device (performance audit). Performance audits must be conducted at a frequency consistent with the objectives of the individual project. Large sampling projects conducted to support regulatory requirements are audited more frequently than small projects intended for screening purposes. Performance audits are designed to provide a quantitative, point-in-time evaluation of the data quality of the sampling and analytical systems being tested. This is accomplished by addressing specific component parts of the overall program. Each performance audit addresses the two general measurement categories of a project:

Chemical analysis of samples, and

Physical measurements supporting the sampling effort

Audit activities consist of challenging the various measurement systems with standards and test equipment traceable to accepted reference standards. Laboratories conducting the analytical work are given performance audit samples prepared by spiking representative samples matrices with target analytes at representative concentrations. Results for these audit samples are tabulated and considered in evaluating the analytical performance and data reporting protocols for each laboratory.

C.2 Reports to Management

During the course of this project, it is the responsibility of the Principal Investigator, the QA Officer, and the sampling team members to see that all measurement procedures are followed as specified, and that measurement data meet prescribed acceptance criteria presented in the Tables in Section B. In the event that a problem arises, it is imperative that prompt action be taken to correct the problem(s).

Corrective Action Report Form (CAR)

The QA officer or other project members initiate a corrective action request in the event that quality control (QC) results exceed acceptability limits, or upon identification of some other problem or potential problem. Method specified responses are presented in Section B, Table B.5.1 and B.5.2. Corrective actions range from the use of data qualifier flags, to reanalysis of the sample or samples affected, to re-sampling and re-analysis, to recommending a change in procedures, depending on the severity of the problem. Problems that require corrective action are documented by the use of Corrective Action Reports (CAR), as presented in Figure C.2.1.

Reestablishment of Control

Procedures for reevaluation and reestablishment of control are summarized in Section B, Tables B.5.1 and B.5.2 for each method.

Recommendation for Corrective Action (RCA)

In addition to the malfunction reporting system for addressing problems identified within this program through the internal quality control system, a system for issuing formal Recommendations for Corrective Actions (RCAs) exists for addressing problems identified through independent quality assurance review. RCAs are issued by the QA Officer or designee. Each RCA addresses a specific problem or deficiency, usually identified during QA audits of laboratory or project operation (Section C.1). Although the RCA system (and form) provides for distinguishing among problems of different urgency, RCA's are typically issued only to address significant, systematic deficiencies. An example, RCA form is presented as Figure C.2.1. Each of these formal written recommendations requires a written response from the responsible party (i.e., to whom the RCA was issued). Copies of each RCA will be provided to the City of West Monroe and DEQ.

Figure C.2.1

Corrective Action Report (CAR)

Part I Initial Information (Furnished by Originator)

Originator: _____ Urgency Level: _____

SAM# _____ Method# _____ Requires resolution for immediate job ☐

Client: _____ Matrix: _____ Requires resolution for future job ☐

Date: _____

To Person Responsible for Action: _____

Present Situation Requiring Action:

Site / Lab: _____ Type: _____ QC Limit ☐ Documentation ☐ System ☐ Other ☐

Date Identified: _____ Time Identified: _____

Date/Time Identified: _____

Description of Situation: (attach supporting data if available)

Recommended Corrective Action of Improvement:

Description: _____ Implemented by: _____

Corrective Action Report (CAR) (Continued)

Part II. Reply / Resolution (Furnished by Technical Director)

Proposed by: _____ Date: _____ Car#: _____

Description: _____ Scheduled Implementation: _____

Part III. Implemented Correction Action (by: _____)

Description: _____ Date Implemented: _____

Part IV. Follow-up Required: Yes ☐ No ☐ (by: _____)

Verified by: _____ Date: _____ Comments: _____

Reports to be Issued

A report describing the status of the project will be issued on a quarterly basis. Copies will be provided to the City of West Monroe and DEQ as well as other agencies specified by West Monroe or DEQ. In addition an annual report will be issued for the project and sent to West Monroe, DEQ and other agencies as directed.

Section D

D.1 Data Review, Validation, and Verification Requirements

The data reduction, validation, and reporting procedures described in this section will ensure that complete documentation is maintained, that transcription and data reduction errors are minimized, the quality of the data is reviewed and documented, and the reported results are properly qualified.

Data Reduction

Generally, all analytical measurements and primary data produced in the laboratory are calculated and reduced to a complete and reportable form by the analyst who performs the work. This includes the sample data and the corresponding quality control data. The analyst calculates the instrument linearity response factor from the instrument and method, the relative percent difference between duplicate analyses, the percent difference between duplicate analyses, the percent recovery for the QC check samples, and the percent spike recovery for the spiked samples. Preferably, the analyst will judge whether his or her data meets the performance criteria for the project, and will perform any corrective activities required. Any major or persistent problems are called to the attention of the Laboratory Director or Principal Investigator.

Data Quality Assessment

The Quality Assurance Officer(s) (Hongjian Xiang, Karen Cummings, Xiangyou Dai) will review and summarize all QC sample results to evaluate the sampling and analytical performance. Reanalysis or resampling may be recommended as a corrective action if data are determined to be unacceptable for the intended application. Corrective actions and data assessment procedures are described in Sections C.1 and C.2. The primary determinants of acceptable data quality for this project will be :

1. Acceptable collection and transport procedures including holding times, sample containers.
2. Blank analyses
3. Laboratory duplicate analysis
4. Analysis of known standards
5. Reagent spike analyses
6. In the case of BOD tests, oxygen drawdown and dilution water requirements must be met.

The Principal Investigator will coordinate the preparation of all formal reports for this project, with input from the Quality Assurance Officer and other project team members. Each report will include a summary and discussion of the results of the QC procedures and QA activities performed as part of the investigation.

D.2 Validation and Verification Methods

The evaluation and assessment of measurement data is required to ensure that the quality assurance (QA) objectives for the project are met and that quantitative measures of data accuracy and precision are provided. The data evaluation procedures, calculations, and applications used for this project are based on the U. S. EPA Guidelines for Assessing and Reporting Data Quality for Environmental Measurements, January, 1983.

Routine quality control procedures in the laboratory are established in the published methods for each constituent and this document. The laboratory is responsible for following these procedures, and operating the analytical systems within statistical control limits. These procedures include proper instruments maintenance, calibration, and continuing calibration checks, and internal quality control samples analyses at appropriate frequencies. An additional ongoing data assessment processes requires the maintenance of control charts for representative quality control (QC) sample analyses in order to monitor laboratory performance. Test results used for the construction of control charts will be based on recovery from spiked samples or from calculations based on analysis of replicates. This is necessary because the actual sample data are autocorrelated and do not conform to a stationary time series. Control charts provide statistical verification that laboratory procedures are in control. They can also indicate when performance problems occur, so that they can be corrected as soon as possible. When reporting the sample data, the laboratory is required to provide the results of associated QC samples analyses so that the project staff can evaluate the performance of the analytical process.

The discussion of data assessment presented in this section pertains to the project-related assessment of data that is performed after data have been reported, and laboratory analyses have been completed.

Data assessment procedures that will be performed for this project include:

Initial review of analytical and field data for complete and accurate documentation, holding time compliance, and required frequency of QC samples;

Evaluation of blank results to identify systematic contamination;

Statistical calculations for accuracy and precision using the appropriate quality control sample results;

Estimates of completeness; and

Assigning data qualifier flags to the data as necessary to reflect limitations identified by the process.

Instrument Response Linearity (Calibration)

Acceptance criteria for instrument linearity are based upon linear regression theory and the resulting correlation coefficient, r , of the line of best fit for the calibration data points. The correlation coefficient is a number which can have values between 0.0 and 1.0. In this particular application a value of zero indicates no correlation between the known standards and the instrument response, a value of 1.0 indicates a perfectly linear response. That is, the line of best fit predicts the instrument measurements exactly. Many pH meters now contain internal software for performing these checks using pH buffers of 4, 7, and 10.

$$r = \frac{n \sum x_i y_i - (\sum x_i)(\sum y_i)}{\sqrt{n \sum x_i^2 - (\sum x_i)^2} \sqrt{n \sum y_i^2 - (\sum y_i)^2}}$$

where: x = calibration standards concentrations (known);
 y = instrument response (prediction)
 n = number of data points (x , y pairs)

All pH meters and spectrophotometers used are calibrated in this way at the start of each day.

Precision

Control limits for quality control sample results, acceptability limits for replicate (not sample) results, and response factor agreement criteria specified for calibration and internal QC checks are based upon precision, in terms of the coefficient of variation (CV) or the relative percent difference (RPD). Precision refers to the closeness of repeated measurements to each other. The standard deviation of a set of replicate measurements is calculated as:

$$S.D. = \sqrt{\frac{\sum (x - \bar{x})^2}{n - 1}}$$

where: x = individual measurements
 \bar{x} = mean value for the individual measurements
 n = number of measurements

A small value indicates that the majority of measurements are near the mean of the replicate data. A large value indicating a wider variation in results. Thus, this value gives a quantitative estimate of the precision of a measurement technique. It should be noted however that the variation about the mean may be function of the absolute concentration being measured. That is, the variation about a mean of 100 may be greater/smaller than the variation about a mean of 1.0.

The coefficient of variation is simply the standard deviation divided by the mean of the data. The resulting number is expressed as a percentage. This form of the result is dimensionless and allows the results of analyses from different populations to be compared directly.

$$c.v. = \frac{S.D.}{\bar{y}} * 100$$

The relative percent difference (RPD) calculation allows for the comparison of two replicate measurements in terms of precision. It is calculated as:

$$RPD = \frac{|m. spike - m. spike dup. |}{\left(\frac{m. spike + m. spike dup.}{2} \right)}$$

At present the Folk Lab uses duplicates, distilled water spikes and matrix spikes to check for precision in measurements. Duplicate test results which do not agree within 10% are flagged and/or deleted from the data set.

Accuracy

Accuracy relates to how closely a measurement agrees with the true value, if it is known. The accuracy of data is typically summarized in terms of relative error (RE). In laboratory work the calculation reflects the degree to which a measured value agrees with a standard, in terms of the true value.

Relative error is calculated as:

$$P.R.E. = \frac{\text{measured value} - \text{true value}}{\text{true value}} * 100$$

This way of expressing accuracy allows for comparison of accuracy at different levels (e.g., different concentrations), and for different parameters of the same type (e.g., different compounds analyzed by the same method). Control samples are typically evaluated using this calculation.

Another calculation is frequently used to assess the accuracy of a procedure. Percent recovery is a calculation used to determine the performance of many of the quality checks. Percent recovery is calculated as:

$$\text{percent recovery} = \frac{\text{measurement value}}{\text{true value}} * 100$$

A calculation used to assess the accuracy of an analytical method involves percent recovery from a spiked matrix sample. In such tests a known amount of the constituent being

measured (the spike) is added to a normal sample (the matrix). The percent spike recovery is determined as:

$$\text{spike recovery} = \frac{\text{spiked sample} - \text{unspiked sample}}{\text{concentration of spike}} * 100$$

Note that the value in the denominator is a known or true value. Thus this calculation compares a difference in two measurements to a known value.

At present analytical accuracy is gauged by comparison of test results to known standards, to spike values. It should be noted that there are no standards available for some tests such as total suspended solids. Test results which do not agree within 10% of the known value are flagged and/or deleted from the data set.

Control Limits

Control limits for central tendency and variability are based on the classical, parametric statistics concept (assuming independent, normally distributed data); that a fixed percentage of future observations will fall within one (67%), two (95%) or three (99%) standard deviations of the mean of a population due solely to random errors in measurement. We can apply this concept to laboratory measurements using a variety of types of quality control samples or sample replicates. For example, consider results from a number (say twenty) of constituent matrix spikes. For such a data set we can compute the mean and standard deviation of the percent recovery values. Based on this information we can compute an upper and lower limit expected for percent recovery based only on random error as:

$$U.C.L. = \mu + 3 S.D.$$

$$L.C.L. = \mu - 3 S.D.$$

Values outside of three standard deviations from the mean would have a less than 1% chance of occurring by chance alone and suggest analytical error or other problem to be investigated. Normally, the mean and standard deviation of the data is computed using only the last twenty or so values. Thus, the control limits may change over time reflecting changes in the underlying samples or changes in analyst technique.

Documentation

Data review to perform each of the above procedures and the implications to natural sample results are discussed in each of the following subsection.

Blank Data Assessment

Reagent blank results indicate whether any of the contaminants reported in the sample results may be attributed to laboratory sources (reagent, glassware, instrumentation) and were not likely present in the sample medium. The most common laboratory contaminants are methylene chloride, phthalate, acetone, and toluene; these are recognized as being ubiquitous in the laboratory environment , and controlling them to within acceptable low levels is part of standard laboratory procedures. Since these analytes are not being measured for this project, these types of contamination will not be of concern.

Results for other types of blanks, such as equipment blanks, are assessed individually. The probable source of contamination is identified, and the associated sample results are qualified as necessary.

D. 3 Reconciliation with Data Quality Objectives

Field sample collection procedures will be established based on information available from Standard Methods and E.P.A. Routine field sampling procedures will include notation of any unusual occurrences or circumstances that may influence the accuracy of representativeness of the data.

Laboratory correction action and procedures have been outlined in Sections C.1 and C.2. Accuracy, precision, and completeness objectives are described below.

Accuracy

As previously defined, accuracy is associated with correctness, and is a comparison between a measured value and a known, or "true" value. Accuracy is calculated from method spikes, matrix spikes, or LCS results. Spike results are reported by the laboratory as percent recovery and are compared to the accuracy stated in Section B.5. Results that do not satisfy the objectives are noted and reasons given, if possible. Generally any results not meeting accuracy or precision requirements are not used for subsequent data analysis, unless noted. For example, it may be impossible to meet holding time requirements for BOD in some situations; these variations are noted.

Method spikes are spikes of reference material into a water matrix. If recovery is outside the established limits, samples from the same batch or similar sample conditions may be qualified. Further investigation or corrective action may be taken to find methods to reduce the interferences.

Precision

Precision is a measure of variability between duplicate or replicate analyses, and is calculated for field and laboratory replicates. By definition, field or total, precision incorporates laboratory precision. Precision is calculated as the relative percent difference (RPD) between duplicate samples or analyses, or matrix spike/matrix spike duplicates as appropriate. The calculated RPDs are compared to the objectives stated in Section B.5. Results that do not satisfy the objectives are qualified and reasons noted. An average RPD may be calculated and reported as a measure of overall analytical precision for compounds with multiple measurements. For poor field duplicate precision, samples collected by the team, or the same day may be affected, and the samples will be qualified. For poor laboratory precision, samples processed and analyzed in the same batch will be closely evaluated, and any anomalous results will be qualified.

The QC officer is responsible for ensuring that data qualifier flags are assigned to the data as required by the established QC criteria, and that they are reported and understood by project members using the data for specific applications. The QC officer and lab director are responsible for initiating corrective action for analytical problems identified during the QC data assessment process.

Completeness

Completeness is calculated after the QC data have been evaluated, and the results applied to the measurement data. In addition to results identified as being outside of the QC limits established for the method, broken or spilled samples, or samples that could not be analyzed for any reason are included in the assessment of completeness. The percentage of valid results is reported as completeness.

For this project, completeness will be calculated as follows:

$$\frac{T - (I + NC)}{T} \times 100\% = \text{Completeness}$$

Where: T = Total number of expected measurements for a method;

I = Number of invalidated results for a method; and

NC = Number of results not collected (e.g., broken bottles, etc.)
for a method.

Section E. References

- A. 1977 Flood Insurance Study summarized in "Hydrology Study for Monroe, West Monroe and Ouachita Parish." (FEMA)
- B. 1979 Study for Olinkraft Corporation, which was to review effects of combining drainage from Judy Slough with Black Bayou drainage.
- C. Review of 1981 Report by the Corps of Engineers, Vicksburg District; "Ouachita River Basin, Monroe-West Monroe, Louisiana, Black Bayou Flood Protection Study".
- D. Review of 1985 and 1986 study of Black Bayou above Thomas Road. In particular, the Highland School Branch, Black Bayou Tributary and Gravel Pit Branch. The study was for the City of West Monroe and was conducted to remap those streams following channel improvements and channel relocations.
- E. In 1990, Ouachita Parish was restudied for revising Flood Insurance Rating Maps. The HEC-1 and HEC-2 computer models were utilized for the drainage streams in Ouachita. In particular, Black Bayou stream modeled from the 1990 restudy will be utilized in the final formulation of this project.
- F. In 1994, this HEC-1 model and HEC-2 model from the 1990 FEMA study was modified based on the proposed construction of a Wal-Mart Supercenter east of Thomas Road and south of the Black Bayou Canal. This study was to account for certain proposed improvements in Wal-Mart for a detention basin and storage facilities. There was no net increase in water surface elevation in Black Bayou at and above this portion of the reach and also no net increase in the water surface elevation of Black Bayou sump based on the study with the Wal-Mart detention basin/storage being constructed.

Each section documents the appropriate laboratory references.